

$\eta'(958)$

$$I^G(J^{PC}) = 0^+(0^{-+})$$

$\eta'(958)$ MASS

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|--------------------|-------------|---|
| 957.78 ± 0.14 OUR AVERAGE | | | | |
| 957.9 ± 0.2 ± 0.6 | 4800 | WURZINGER 96 | SPEC | 1.68 $pd \rightarrow {}^3\text{He}\eta'$ |
| 959 ± 1 | 630 | BELADIDZE 92C | VES | 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$ |
| 958 ± 1 | 340 | ARMSTRONG 91B | OMEG | 300 $pp \rightarrow pp\eta\pi^+\pi^-$ |
| 958.2 ± 0.4 | 622 | AUGUSTIN 90 | DM2 | $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$ |
| 957.8 ± 0.2 | 2420 | AUGUSTIN 90 | DM2 | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |
| 956.3 ± 1.0 | 143 | GIDAL 87 | MRK2 | $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$ |
| 957.46 ± 0.33 | | DUANE 74 | MMS | $\pi^- p \rightarrow n\text{MM}$ |
| 958.2 ± 0.5 | 1414 | DANBURG 73 | HBC | 2.2 $K^- p \rightarrow \Lambda X^0$ |
| 958 ± 1 | 400 | JACOBS 73 | HBC | 2.9 $K^- p \rightarrow \Lambda X^0$ |
| 956.1 ± 1.1 | 3415 | BASILE 71 | CNTR | 1.6 $\pi^- p \rightarrow nX^0$ |
| 957.4 ± 1.4 | 535 | BASILE 71 | CNTR | 1.6 $\pi^- p \rightarrow nX^0$ |
| 957 ± 1 | | RITTENBERG 69 | HBC | 1.7–2.7 $K^- p$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 957.5 ± 0.2 | | BAI 04J | BES2 | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |

$\eta'(958)$ WIDTH

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |
|---|-------------|--------------------|-------------|------------|---|
| 0.203 ± 0.016 OUR FIT Error includes scale factor of 1.3. | | | | | |
| 0.30 ± 0.09 OUR AVERAGE | | | | | |
| 0.40 ± 0.22 | 4800 | WURZINGER 96 | SPEC | | 1.68 $pd \rightarrow {}^3\text{He}\eta'$ |
| 0.28 ± 0.10 | 1000 | BINNIE 79 | MMS | 0 | $\pi^- p \rightarrow n\text{MM}$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | | |
| 0.20 ± 0.04 | | BAI 04J | BES2 | | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |

$\eta'(958)$ DECAY MODES

| Mode | Fraction (Γ_i/Γ) | Scale factor/ Confidence level |
|--|-----------------------------------|-----------------------------------|
| $\Gamma_1 \quad \pi^+\pi^-\eta$ | (44.5 ± 1.4) % | S=1.1 |
| $\Gamma_2 \quad \rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$) | (29.4 ± 0.9) % | S=1.1 |
| $\Gamma_3 \quad \pi^0\pi^0\eta$ | (20.8 ± 1.2) % | S=1.2 |
| $\Gamma_4 \quad \omega\gamma$ | (3.03 ± 0.31) % | |
| $\Gamma_5 \quad \gamma\gamma$ | (2.12 ± 0.14) % | S=1.3 |
| $\Gamma_6 \quad 3\pi^0$ | (1.55 ± 0.26) × 10 ⁻³ | |

| | | | | | |
|---------------|------------------------------------|--|----------------------------------|------------------|--------|
| Γ_7 | $\mu^+ \mu^- \gamma$ | | $(1.04 \pm 0.26) \times 10^{-4}$ | | |
| Γ_8 | $\pi^+ \pi^- \pi^0$ | | < 5 | % | CL=90% |
| Γ_9 | $\pi^0 \rho^0$ | | < 4 | % | CL=90% |
| Γ_{10} | $\pi^+ \pi^+ \pi^- \pi^-$ | | < 1 | % | CL=90% |
| Γ_{11} | $\pi^+ \pi^+ \pi^- \pi^-$ neutrals | | < 1 | % | CL=95% |
| Γ_{12} | $\pi^+ \pi^+ \pi^- \pi^- \pi^0$ | | < 1 | % | CL=90% |
| Γ_{13} | 6π | | < 1 | % | CL=90% |
| Γ_{14} | $\pi^+ \pi^- e^+ e^-$ | | < 6 | $\times 10^{-3}$ | CL=90% |
| Γ_{15} | $\gamma e^+ e^-$ | | < 9 | $\times 10^{-4}$ | CL=90% |
| Γ_{16} | $\pi^0 \gamma \gamma$ | | < 8 | $\times 10^{-4}$ | CL=90% |
| Γ_{17} | $4\pi^0$ | | < 5 | $\times 10^{-4}$ | CL=90% |
| Γ_{18} | $e^+ e^-$ | | < 2.1 | $\times 10^{-7}$ | CL=90% |
| Γ_{19} | invisible | | < 1.4 | $\times 10^{-3}$ | CL=90% |

**Charge conjugation (C), Parity (P),
Lepton family number (LF) violating modes**

| | | | | | |
|---------------|---------------------|---------|---------|------------------|--------|
| Γ_{20} | $\pi^+ \pi^-$ | P, CP | < 2 | % | CL=90% |
| Γ_{21} | $\pi^0 \pi^0$ | P, CP | < 9 | $\times 10^{-4}$ | CL=90% |
| Γ_{22} | $\pi^0 e^+ e^-$ | C [a] | < 1.4 | $\times 10^{-3}$ | CL=90% |
| Γ_{23} | $\eta e^+ e^-$ | C [a] | < 2.4 | $\times 10^{-3}$ | CL=90% |
| Γ_{24} | 3γ | C | < 1.0 | $\times 10^{-4}$ | CL=90% |
| Γ_{25} | $\mu^+ \mu^- \pi^0$ | C [a] | < 6.0 | $\times 10^{-5}$ | CL=90% |
| Γ_{26} | $\mu^+ \mu^- \eta$ | C [a] | < 1.5 | $\times 10^{-5}$ | CL=90% |
| Γ_{27} | $e\mu$ | LF | < 4.7 | $\times 10^{-4}$ | CL=90% |

[a] C parity forbids this to occur as a single-photon process.

CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, 2 combinations of partial widths obtained from integrated cross section, and 16 branching ratios uses 49 measurements and one constraint to determine 7 parameters. The overall fit has a $\chi^2 = 36.7$ for 43 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i , including the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

| | | | | | | |
|----------|-------|-------|-------|-------|-------|-------|
| x_2 | -34 | | | | | |
| x_3 | -78 | -29 | | | | |
| x_4 | -35 | -24 | 32 | | | |
| x_5 | -26 | -12 | 26 | 8 | | |
| x_6 | -28 | -11 | 35 | 11 | 9 | |
| Γ | 32 | -2 | -24 | -5 | -88 | -8 |
| | x_1 | x_2 | x_3 | x_4 | x_5 | x_6 |

| Mode | Rate (MeV) | Scale factor |
|---|----------------------------------|--------------|
| Γ_1 $\pi^+ \pi^- \eta$ | 0.090 \pm 0.008 | 1.2 |
| Γ_2 $\rho^0 \gamma$ (including non-resonant $\pi^+ \pi^- \gamma$) | 0.060 \pm 0.005 | 1.2 |
| Γ_3 $\pi^0 \pi^0 \eta$ | 0.042 \pm 0.004 | 1.6 |
| Γ_4 $\omega \gamma$ | 0.0062 \pm 0.0008 | 1.2 |
| Γ_5 $\gamma \gamma$ | 0.00430 \pm 0.00015 | 1.1 |
| Γ_6 $3\pi^0$ | (3.2 \pm 0.6) $\times 10^{-4}$ | 1.1 |

$\eta'(958)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_5

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------------------------------------|-----------------------|---------|--|
| 4.30 \pm 0.15 OUR FIT | Error includes scale factor of 1.1. | | | |
| 4.28 \pm 0.19 OUR AVERAGE | | | | |
| 4.17 \pm 0.10 \pm 0.27 | 2000 | ¹ ACCIARRI | 98B L3 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \gamma$ |
| 4.53 \pm 0.29 \pm 0.51 | 266 | KARCH | 92 CBAL | $e^+ e^- \rightarrow e^+ e^- \eta \pi^0 \pi^0$ |
| 3.61 \pm 0.13 \pm 0.48 | | ² BEHREND | 91 CELL | $e^+ e^- \rightarrow e^+ e^- \eta'(958)$ |
| 4.6 \pm 1.1 \pm 0.6 | 23 | BARU | 90 MD1 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \gamma$ |
| 4.57 \pm 0.25 \pm 0.44 | | BUTLER | 90 MRK2 | $e^+ e^- \rightarrow e^+ e^- \eta'(958)$ |
| 5.08 \pm 0.24 \pm 0.71 | 547 | ³ ROE | 90 ASP | $e^+ e^- \rightarrow e^+ e^- 2\gamma$ |
| 3.8 \pm 0.7 \pm 0.6 | 34 | AIHARA | 88C TPC | $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$ |
| 4.9 \pm 0.5 \pm 0.5 | 136 | ⁴ WILLIAMS | 88 CBAL | $e^+ e^- \rightarrow e^+ e^- 2\gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

| | | | | | |
|-----------------------|-----|---------------------|-----|------|---|
| $4.7 \pm 0.6 \pm 0.9$ | 143 | ⁵ GIDAL | 87 | MRK2 | $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$ |
| 4.0 ± 0.9 | | ⁶ BARTEL | 85E | JADE | $e^+e^- \rightarrow e^+e^-2\gamma$ |

- ¹ No non-resonant $\pi^+\pi^-$ contribution found.
- ² Reevaluated by us using $B(\eta' \rightarrow \rho(770)\gamma) = (30.2 \pm 1.3)\%$.
- ³ Reevaluated by us using $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$.
- ⁴ Reevaluated by us using $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$.
- ⁵ Superseded by BUTLER 90.
- ⁶ Systematic error not evaluated.

$\eta'(958) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

This combination of a partial width with the partial width into $\gamma\gamma$ and with the total width is obtained from the integrated cross section into channel(i) in the $\gamma\gamma$ annihilation.

$\Gamma(\gamma\gamma) \times \Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma_{\text{total}} \quad \Gamma_5\Gamma_2/\Gamma$

| VALUE (keV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|---|-------------------------------------|-------------|------|---|
| 1.26 ± 0.05 OUR FIT | Error includes scale factor of 1.1. | | | |
| 1.26 ± 0.07 OUR AVERAGE | Error includes scale factor of 1.2. | | | |
| $1.09 \pm 0.04 \pm 0.13$ | | BEHREND | 91 | CELL $e^+e^- \rightarrow e^+e^-\rho(770)^0\gamma$ |
| $1.35 \pm 0.09 \pm 0.21$ | | AIHARA | 87 | TPC $e^+e^- \rightarrow e^+e^-\rho\gamma$ |
| $1.13 \pm 0.04 \pm 0.13$ | 867 | ALBRECHT | 87B | ARG $e^+e^- \rightarrow e^+e^-\rho\gamma$ |
| $1.53 \pm 0.09 \pm 0.21$ | | ALTHOFF | 84E | TASS $e^+e^- \rightarrow e^+e^-\rho\gamma$ |
| $1.14 \pm 0.08 \pm 0.11$ | 243 | BERGER | 84B | PLUT $e^+e^- \rightarrow e^+e^-\rho\gamma$ |
| $1.73 \pm 0.34 \pm 0.35$ | 95 | JENNI | 83 | MRK2 $e^+e^- \rightarrow e^+e^-\rho\gamma$ |
| $1.49 \pm 0.13 \pm 0.027$ | 213 | BARTEL | 82B | JADE $e^+e^- \rightarrow e^+e^-\rho\gamma$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| $1.85 \pm 0.31 \pm 0.24$ | 43 | BEHREND | 83B | CELL $e^+e^- \rightarrow e^+e^-\rho\gamma$ |

$\Gamma(\gamma\gamma) \times \Gamma(\pi^0\pi^0\eta)/\Gamma_{\text{total}} \quad \Gamma_5\Gamma_3/\Gamma$

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|---|-------------------------------------|------|--|
| 0.89 ± 0.06 OUR FIT | Error includes scale factor of 1.1. | | |
| $0.92 \pm 0.06 \pm 0.11$ | ⁷ KARCH | 92 | CBAL $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $0.95 \pm 0.05 \pm 0.08$ | ⁸ KARCH | 90 | CBAL $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$ |
| $1.00 \pm 0.08 \pm 0.10$ | ^{8,9} ANTREASYAN | 87 | CBAL $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$ |

- ⁷ Reevaluated by us using $B(\eta \rightarrow \gamma\gamma) = (39.21 \pm 0.34)\%$. Supersedes ANTREASYAN 87 and KARCH 90.
- ⁸ Superseded by KARCH 92.
- ⁹ Using $BR(\eta \rightarrow 2\gamma) = (38.9 \pm 0.5)\%$.

$\eta'(958)$ DECAY PARAMETERS

$|\text{MATRIX ELEMENT}|^2 = |1 + \alpha y|^2 + cx + dx^2$

α decay parameter

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|------------------------------|-------------|--|
| -0.065 ± 0.009 OUR AVERAGE | | | | |
| $-0.072 \pm 0.012 \pm 0.006$ | 7k | ¹⁰ AMELIN | 05A VES | 28 $\pi^- A \rightarrow \eta' \pi^- A^*$ |
| -0.058 ± 0.013 | | ^{11,12} ALDE | 86 GAM2 | 38 $\pi^- p \rightarrow n \eta 2\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| -0.08 ± 0.03 | | ^{11,12} KALBFLEISCH | 74 RVUE | $\eta' \rightarrow \eta \pi^+ \pi^-$ |

¹⁰ This is a real part of α while $\text{Im}(\alpha) = 0.0 \pm 0.1 \pm 0.0$.
¹¹ May not necessarily be the same for $\eta' \rightarrow \eta \pi^+ \pi^-$ and $\eta' \rightarrow \eta \pi^0 \pi^0$.
¹² Assuming $\text{Im}(\alpha) = 0$, $c = 0$.

c C-violating decay parameter

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|--------------------|-------------|--|
| $0.020 \pm 0.018 \pm 0.004$ | 7k | AMELIN | 05A VES | 28 $\pi^- A \rightarrow \eta' \pi^- A^*$ |

$\eta'(958)$ β PARAMETER

$|\text{MATRIX ELEMENT}|^2 = (1 + 2\beta Z)$

See the "Note on η Decay Parameters" in our 1994 edition Physical Review **D50** 1173 (1994), p. 1454.

β decay parameter

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------------------------|--------------------|-------------|-----------------------------------|
| -0.1 ± 0.3 | ALDE | 87B GAM2 | 38 $\pi^- p \rightarrow n 3\pi^0$ |

$\eta'(958)$ BRANCHING RATIOS

$\Gamma(\pi^+ \pi^- \eta(\text{charged decay}))/\Gamma_{\text{total}} \quad \mathbf{0.286\Gamma_1/\Gamma}$

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------------------------------|--------------------|-------------|--|
| 0.127 ± 0.004 OUR FIT | Error includes scale factor of 1.1. | | | |
| 0.116 ± 0.013 OUR AVERAGE | | | | |
| 0.123 ± 0.014 | 107 | RITTENBERG | 69 HBC | 1.7–2.7 $K^- p$ |
| 0.10 ± 0.04 | 10 | LONDON | 66 HBC | 2.24 $K^- p \rightarrow \Lambda \pi^+ \pi^- \pi^+ \pi^- \pi^0$ |
| 0.07 ± 0.04 | 7 | BADIER | 65B HBC | 3 $K^- p$ |

$\Gamma(\pi^+ \pi^- \eta(\text{neutral decay}))/\Gamma_{\text{total}} \quad \mathbf{0.714\Gamma_1/\Gamma}$

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------------------------------|--------------------|-------------|-----------------|
| 0.318 ± 0.010 OUR FIT | Error includes scale factor of 1.1. | | | |
| 0.314 ± 0.026 | 281 | RITTENBERG | 69 HBC | 1.7–2.7 $K^- p$ |

$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma_{\text{total}}$ Γ_2/Γ

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------------------------|-------------------------------------|--------------------|-------------|---|
| 0.294±0.009 OUR FIT | Error includes scale factor of 1.1. | | | |
| 0.319±0.030 OUR AVERAGE | | | | |
| 0.329±0.033 | 298 | RITTENBERG 69 | HBC | 1.7–2.7 K^-p |
| 0.2 ±0.1 | 20 | LONDON 66 | HBC | 2.24 $K^-p \rightarrow \Lambda\pi^+\pi^-\gamma$ |
| 0.34 ±0.09 | 35 | BADIER 65B | HBC | 3 K^-p |

$\Gamma(\pi^+\pi^-\eta)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$ Γ_1/Γ_2

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|------------------|--------------------|-------------|----------------------------------|
| 1.45±0.07 | ABLIKIM 06E | BES2 | $J/\psi \rightarrow \eta'\gamma$ |

$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma(\pi^+\pi^-\eta(\text{neutral decay}))$ $\Gamma_2/0.714\Gamma_1$

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|------------------------------|-------------------------------------|--------------------|-------------|--|
| 0.92±0.05 OUR FIT | Error includes scale factor of 1.1. | | | |
| 0.97±0.09 OUR AVERAGE | | | | |
| 0.70±0.22 | | AMSLER 04B | CBAR | 0 $\bar{p}p \rightarrow \pi^+\pi^-\eta$ |
| 1.07±0.17 | | BELADIDZE 92C | VES | 36 $\pi^-\text{Be} \rightarrow \pi^-\eta'/\eta\text{Be}$ |
| 0.92±0.14 | 473 | DANBURG 73 | HBC | 2.2 $K^-p \rightarrow \Lambda X^0$ |
| 1.11±0.18 | 192 | JACOBS 73 | HBC | 2.9 $K^-p \rightarrow \Lambda X^0$ |

$\Gamma(\pi^0\pi^0\eta(3\pi^0\text{ decay}))/\Gamma_{\text{total}}$ $0.321\Gamma_3/\Gamma$

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------------------|-------------------------------------|--------------------|-------------|----------------|
| 0.067±0.004 OUR FIT | Error includes scale factor of 1.2. | | | |
| 0.11 ±0.06 | 4 | BENSINGER 70 | DBC | 2.2 π^+d |

$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma(\pi\pi\eta)$ $\Gamma_2/(\Gamma_1+\Gamma_3)$

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------------------------|-------------------------------------|-------------|----------------------------------|
| 0.450±0.020 OUR FIT | Error includes scale factor of 1.1. | | |
| 0.426±0.028 OUR AVERAGE | | | |
| 0.43 ±0.02 ±0.02 | BARBERIS 98C | OMEG | 450 $pp \rightarrow p_f\eta'p_s$ |
| 0.31 ±0.15 | DAVIS 68 | HBC | 5.5 K^-p |

$\Gamma(\omega\gamma)/\Gamma(\pi^+\pi^-\eta)$ Γ_4/Γ_1

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------------------|-------------------------------------|--------------------|-------------|----------------|
| 0.068±0.008 OUR FIT | Error includes scale factor of 1.1. | | | |
| 0.068±0.013 | 68 | ZANFINO 77 | ASPK | 8.4 π^-p |

$\Gamma(\omega\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_4/Γ_3

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------------------|--------------------|-------------|----------------------------------|
| 0.146±0.014 OUR FIT | | | |
| 0.147±0.016 | ALDE 87B | GAM2 | 38 $\pi^-p \rightarrow n4\gamma$ |

$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/[\Gamma(\pi^+\pi^-\eta) + \Gamma(\pi^0\pi^0\eta) + \Gamma(\omega\gamma)]$ $\Gamma_2/(\Gamma_1+\Gamma_3+\Gamma_4)$

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------------------|-------------------------------------|-------------|----------------|
| 0.430±0.019 OUR FIT | Error includes scale factor of 1.1. | | |
| 0.25 ±0.14 | DAUBER 64 | HBC | 1.95 K^-p |

$$\frac{[\Gamma(\pi^0\pi^0\eta(\text{charged decay})) + \Gamma(\omega(\text{charged decay})\gamma)]}{\Gamma_{\text{total}}} \quad (0.286\Gamma_3 + 0.89\Gamma_4)/\Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------|-------------------------------------|---------------|------|-----------------|
| 0.087±0.005 OUR FIT | Error includes scale factor of 1.2. | | | |
| 0.045±0.029 | 42 | RITTENBERG 69 | HBC | 1.7–2.7 $K^- p$ |

$$\frac{\Gamma(\pi^+\pi^-\text{ neutrals})}{\Gamma_{\text{total}}} \quad (0.714\Gamma_1 + 0.286\Gamma_3 + 0.89\Gamma_4)/\Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|-------------------------------------|-------------|---------|--|
| 0.404±0.007 OUR FIT | Error includes scale factor of 1.1. | | | |
| 0.36 ±0.05 OUR AVERAGE | | | | |
| 0.4 ±0.1 | 39 | LONDON | 66 HBC | 2.24 $K^- p \rightarrow \Lambda\pi^+\pi^-\text{ neutrals}$ |
| 0.35 ±0.06 | 33 | BADIER | 65B HBC | 3 $K^- p$ |

$$\frac{\Gamma(\gamma\gamma)}{\Gamma_{\text{total}}} \quad \Gamma_5/\Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-------------------------------------|-------------|---------|---|
| 0.0212±0.0014 OUR FIT | Error includes scale factor of 1.3. | | | |
| 0.0196±0.0015 OUR AVERAGE | | | | |
| 0.0200±0.0018 | 13 | STANTON | 80 SPEC | 8.45 $\pi^- p \rightarrow n\pi^+\pi^-2\gamma$ |
| 0.025 ±0.007 | | DUANE | 74 MMS | $\pi^- p \rightarrow nMM$ |
| 0.0171±0.0033 | 68 | DALPIAZ | 72 CNTR | 1.6 $\pi^- p \rightarrow nX^0$ |
| 0.020 ^{+0.008} _{-0.006} | 31 | HARVEY | 71 OSPK | 3.65 $\pi^- p \rightarrow nX^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

| | | | | |
|--------------|------|--------------------|---------|--------------------------------------|
| 0.018 ±0.002 | 6000 | ¹⁴ APEL | 79 NICE | 15–40 $\pi^- p \rightarrow n2\gamma$ |
|--------------|------|--------------------|---------|--------------------------------------|

¹³ Includes APEL 79 result.

¹⁴ Data is included in STANTON 80 evaluation.

$$\frac{\Gamma(\gamma\gamma)}{\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))} \quad \Gamma_5/\Gamma_2$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------|-------------|------|----------------------------------|
| 0.080±0.008 | ABLIKIM 06E | BES2 | $J/\psi \rightarrow \eta'\gamma$ |

$$\frac{\Gamma(\gamma\gamma)}{\Gamma(\pi^0\pi^0\eta)} \quad \Gamma_5/\Gamma_3$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|-------------------------------------|------|-----------------------------------|
| 0.102±0.007 OUR FIT | Error includes scale factor of 1.6. | | |
| 0.105±0.010 OUR AVERAGE | Error includes scale factor of 1.9. | | |
| 0.091±0.009 | AMSLER 93 | CBAR | 0.0 $\bar{p}p$ |
| 0.112±0.002±0.006 | ALDE 87B | GAM2 | 38 $\pi^- p \rightarrow n2\gamma$ |

$$\frac{\Gamma(\gamma\gamma)}{\Gamma(\pi^0\pi^0\eta(\text{neutral decay}))} \quad \Gamma_5/0.714\Gamma_3$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------|-------------------------------------|-------------|---------|--------------------------------|
| 0.142±0.010 OUR FIT | Error includes scale factor of 1.6. | | | |
| 0.188±0.058 | 16 | APEL | 72 OSPK | 3.8 $\pi^- p \rightarrow nX^0$ |

$$\frac{\Gamma(\text{neutrals})}{\Gamma_{\text{total}}} \quad (0.714\Gamma_3 + 0.09\Gamma_4 + \Gamma_5)/\Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|-------------------------------------|---------------|---------|--------------------------------|
| 0.173±0.009 OUR FIT | Error includes scale factor of 1.2. | | | |
| 0.187±0.017 OUR AVERAGE | | | | |
| 0.185±0.022 | 535 | BASILE | 71 CNTR | 1.6 $\pi^- p \rightarrow nX^0$ |
| 0.189±0.026 | 123 | RITTENBERG 69 | HBC | 1.7–2.7 $K^- p$ |

| $\Gamma(3\pi^0)/\Gamma(\pi^0\pi^0\eta)$ | | | | | Γ_6/Γ_3 |
|---|-------------|--------------------|-------------|----------------|--|
| <u>VALUE (units 10^{-4})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| 74±12 OUR FIT | | | | | |
| 74±12 OUR AVERAGE | | | | | |
| 74±15 | | ALDE | 87B | GAM2 | 38 $\pi^- p \rightarrow n6\gamma$ |
| 75±18 | | BINON | 84 | GAM2 | 30–40 $\pi^- p \rightarrow n6\gamma$ |
| $\Gamma(\mu^+\mu^-\gamma)/\Gamma(\gamma\gamma)$ | | | | | Γ_7/Γ_5 |
| <u>VALUE (units 10^{-3})</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| 4.9±1.2 | 33 | VIKTOROV | 80 | CNTR | 25,33 $\pi^- p \rightarrow 2\mu\gamma$ |
| $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ | | | | | Γ_8/Γ |
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.05 | 90 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.09 | 95 | DANBURG | 73 | HBC | 2.2 $K^- p \rightarrow \Lambda X^0$ |
| $\Gamma(\pi^0\rho^0)/\Gamma_{\text{total}}$ | | | | | Γ_9/Γ |
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.04 | 90 | RITTENBERG | 65 | HBC | 2.7 $K^- p$ |
| $\Gamma(\pi^+\pi^+\pi^-\pi^-)/\Gamma_{\text{total}}$ | | | | | Γ_{10}/Γ |
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.01 | 90 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |
| $\Gamma(\pi^+\pi^+\pi^-\pi^- \text{ neutrals})/\Gamma_{\text{total}}$ | | | | | Γ_{11}/Γ |
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.01 | 95 | DANBURG | 73 | HBC | 2.2 $K^- p \rightarrow \Lambda X^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.01 | 90 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |
| $\Gamma(\pi^+\pi^+\pi^-\pi^-\pi^0)/\Gamma_{\text{total}}$ | | | | | Γ_{12}/Γ |
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.01 | 90 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^- p$ |
| $\Gamma(6\pi)/\Gamma_{\text{total}}$ | | | | | Γ_{13}/Γ |
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.01 | 90 | LONDON | 66 | HBC | Compilation |
| $\Gamma(\pi^+\pi^-\text{e}^+\text{e}^-)/\Gamma_{\text{total}}$ | | | | | Γ_{14}/Γ |
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.006 | 90 | RITTENBERG | 65 | HBC | 2.7 $K^- p$ |
| $\Gamma(\gamma\text{e}^+\text{e}^-)/\Gamma_{\text{total}}$ | | | | | Γ_{15}/Γ |
| <u>VALUE (units 10^{-3})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.9 | 90 | BRIERE | 00 | CLEO | 10.6 e^+e^- |

$\Gamma(\pi^0\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_{16}/Γ_3

| <u>VALUE (units 10^{-4})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|--|
| <37 | 90 | ALDE | 87B | GAM2 38 $\pi^- p \rightarrow n4\gamma$ |

$\Gamma(4\pi^0)/\Gamma(\pi^0\pi^0\eta)$ Γ_{17}/Γ_3

| <u>VALUE (units 10^{-4})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|--|
| <23 | 90 | ALDE | 87B | GAM2 38 $\pi^- p \rightarrow n8\gamma$ |

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$ Γ_{18}/Γ

| <u>VALUE (units 10^{-7})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|--|
| <2.1 | 90 | VOROBYEV | 88 | ND $e^+e^- \rightarrow \pi^+\pi^-\eta$ |

$\Gamma(\text{invisible})/\Gamma(\gamma\gamma)$ Γ_{19}/Γ_5

| <u>VALUE (units 10^{-2})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|------------------------------------|
| <6.69 | 90 | ABLIKIM | 06Q | BES $J/\psi \rightarrow \phi\eta'$ |

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{20}/Γ

| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|-----------------|------------|--------------------|-------------|---------------------|
| <0.02 | 90 | RITTENBERG | 69 | HBC 1.7–2.7 $K^- p$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

| | | | | |
|-------|----|---------|----|---|
| <0.08 | 95 | DANBURG | 73 | HBC 2.2 $K^- p \rightarrow \Lambda X^0$ |
|-------|----|---------|----|---|

$\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$ Γ_{21}/Γ_3

| <u>VALUE (units 10^{-4})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|--|
| <45 | 90 | ALDE | 87B | GAM2 38 $\pi^- p \rightarrow n4\gamma$ |

$\Gamma(\pi^0e^+e^-)/\Gamma_{\text{total}}$ Γ_{22}/Γ

| <u>VALUE (units 10^{-3})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|--------------------|
| < 1.4 | 90 | BRIERE | 00 | CLEO 10.6 e^+e^- |

• • • We do not use the following data for averages, fits, limits, etc. • • •

| | | | | |
|-----|----|------------|----|-----------------|
| <13 | 90 | RITTENBERG | 65 | HBC 2.7 $K^- p$ |
|-----|----|------------|----|-----------------|

$\Gamma(\eta e^+e^-)/\Gamma_{\text{total}}$ Γ_{23}/Γ

| <u>VALUE (units 10^{-3})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|--------------------|
| < 2.4 | 90 | BRIERE | 00 | CLEO 10.6 e^+e^- |

• • • We do not use the following data for averages, fits, limits, etc. • • •

| | | | | |
|-----|----|------------|----|-----------------|
| <11 | 90 | RITTENBERG | 65 | HBC 2.7 $K^- p$ |
|-----|----|------------|----|-----------------|

$\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$ Γ_{24}/Γ_3

| <u>VALUE (units 10^{-4})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|--|
| <4.6 | 90 | ALDE | 87B | GAM2 38 $\pi^- p \rightarrow n3\gamma$ |

$\Gamma(\mu^+\mu^-\pi^0)/\Gamma_{\text{total}}$ Γ_{25}/Γ

| <u>VALUE (units 10^{-5})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|---------------------------------------|
| <6.0 | 90 | DZHELYADIN | 81 | CNTR 30 $\pi^- p \rightarrow \eta' n$ |

| $\Gamma(\mu^+ \mu^- \eta)/\Gamma_{\text{total}}$ | | | | | Γ_{26}/Γ |
|--|-----|---------------|------|----------------------------------|----------------------|
| VALUE (units 10^{-5}) | CL% | DOCUMENT ID | TECN | COMMENT | |
| <1.5 | 90 | DZHELYADIN 81 | CNTR | $30 \pi^- p \rightarrow \eta' n$ | |

| $\Gamma(e\mu)/\Gamma_{\text{total}}$ | | | | | Γ_{27}/Γ |
|--------------------------------------|-----|-------------|------|----------------|----------------------|
| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT | |
| <4.7 | 90 | BRIERE 00 | CLEO | $10.6 e^+ e^-$ | |

$\eta'(958)$ C-NONCONSERVING DECAY PARAMETER

See the note on η decay parameters in the Stable Particle Particle Listings for definition of this parameter.

DECAY ASYMMETRY PARAMETER FOR $\pi^+ \pi^- \gamma$

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|----------------|------|---|
| -0.01 ± 0.04 OUR AVERAGE | | | | |
| -0.019 ± 0.056 | | AIHARA 87 | TPC | $2\gamma \rightarrow \pi^+ \pi^- \gamma$ |
| -0.069 ± 0.078 | 295 | GRIGORIAN 75 | STRC | $2.1 \pi^- p$ |
| 0.00 ± 0.10 | 103 | KALBFLEISCH 75 | HBC | $2.18 K^- p \rightarrow \Lambda \pi^+ \pi^- \gamma$ |
| 0.07 ± 0.08 | 152 | RITTENBERG 65 | HBC | $2.1-2.7 K^- p$ |

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